

Synopsis V1.0
Displacement Damage Testing of the Agilent HCPL 6751
Optocoupler (8302401FC & 8302401FC-X03)

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I. Introduction

This study was undertaken to determine the displacement damage susceptibility of the Agilent HCPL 6751 Optocoupler (8302401FC-X03). The device was exposed then tested using protons at the Indiana University Cyclotron Facility (IUCF).

II. Devices Tested

The Agilent HCPL 6751 are quad channel, hermetically sealed optocouplers. Each channel contains a GaAsP light emitting diode that is optically coupled to an integrated high gain photon detector. The high gain output stage features an open collector output providing both lower saturation voltage and higher signaling speed than possible with conventional photo- Darlington optocouplers. The shallow depth and small junctions offered by the IC process provides better radiation immunity than conventional phototransistor optocouplers.

The sample size used during the tests was three devices. The devices were manufactured by Agilent and were characterized prior to exposure. The devices tested had a Lot Date Code of 0251. All DUTs' package markings were identical and are given in the table below:

TOP	BOTTOM
A Q0251	EL
HCPL-6751	
8302401FC	
SGP	
* 50434	

III. Test Facilities

Facility: Indiana University Cyclotron Facility (IUCF)

Protons: 73.7 MeV

Flux: 4.8×10^8 to 2.2×10^9 protons/cm²/s.

IV. Test Methods

For the exposure part of the testing, the input was set to a dc value (grounded) to maintain the LED in the off state. The output stage was biased at 5 volts. Prior to the first exposure, pre-rad measurements were done using a parametric analyzer (Model HP4156B). The Devices Under Test (DUTs) were then exposed to a certain level of proton fluence and read again using the parametric analyzer (PA). This process was continued until the final exposure level had been reached. Six different exposure levels were used for this test (1, 3, 6, 10, 30 and 100×10^{10} protons/cm²). The two characteristics that were measure with the PA were the “DC Transfer Characteristics” and the “Current Transfer Ratio vs. Input Diode Forward Current” (Figures 2 and 3 from the product datasheet).

V. Results

The dc transfer characteristics were measured for each of three DUTs and each of four channels on each DUT, yielding 12 pages of plots (Appendix A). Each page of this appendix has four plots that are for the four forward current used in the measurements (0.5, 1.5, 3.0 and 5.0 mA). Each plot contains seven traces – one for the pre-rad and one for each of the six proton exposures, as indicated by each plot legend.

The current transfer ratio (CTR) characteristics were measure for each of the three DUTs, yielding three pages of plots (Appendix B). Each page of this appendix has four plots for the four channels of each DUT. Each plot contains seven traces – one for the pre-rad and one for each of the six proton exposures, as indicated by each plot legend.

A general statement that can be made about the dc transfer data is that except for the two lowest forward current cases, the devices had very little change in dc characteristics, even to 1×10^{12} protons/cm². The same trend can be seen looking at the higher current end of the CTR curves. However, the CTR value at these currents is significantly lower that the peak CTR at lower drive currents.

It should also be noted that DUT behaved substantially better than either DUTs 2 or 3. All three devices were from the same LDC so the differences should be expected with a lot and the worst-case response should be assumed.

VI. Recommendations

In general, devices are categorized based on proton test data into one of the four following categories:

Category 1 – Recommended for usage in all NASA/GSFC spaceflight applications.

Category 2 – Recommended for usage in NASA/GSFC spaceflight applications, but may require mitigation techniques.

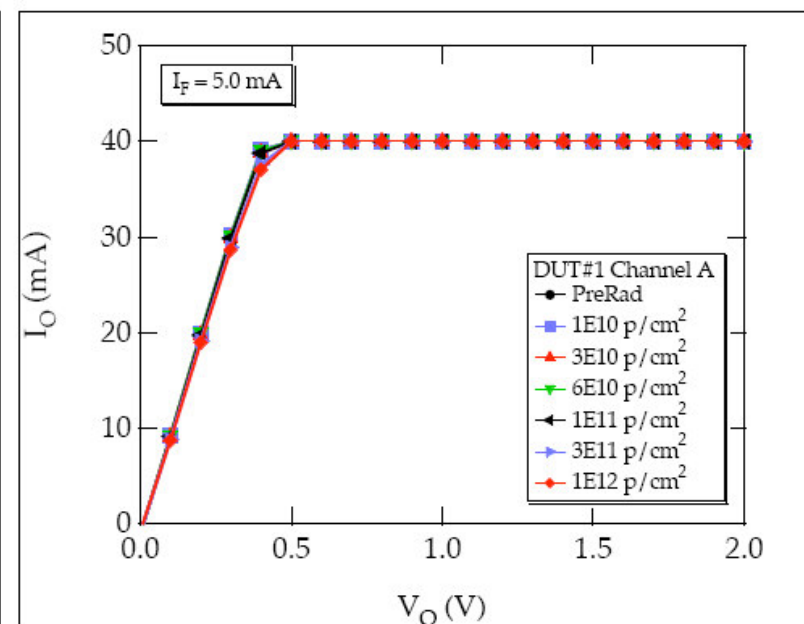
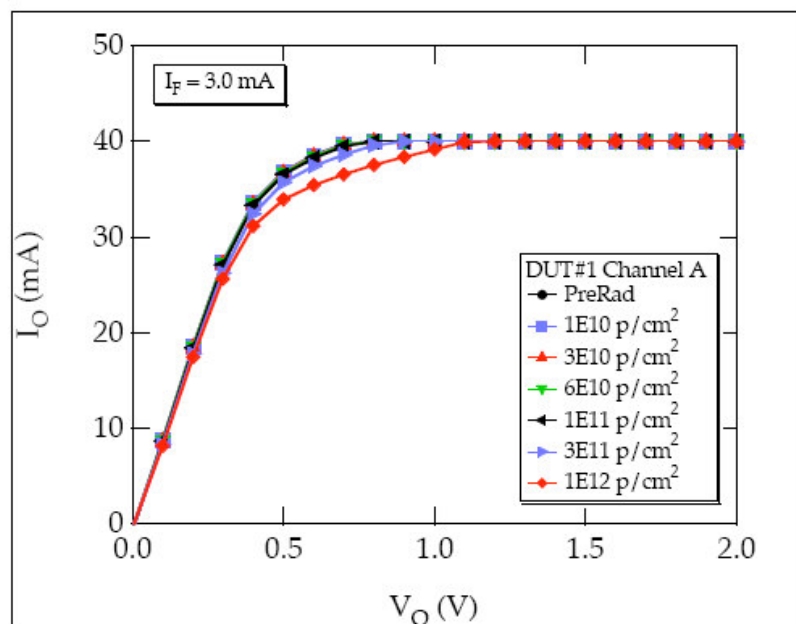
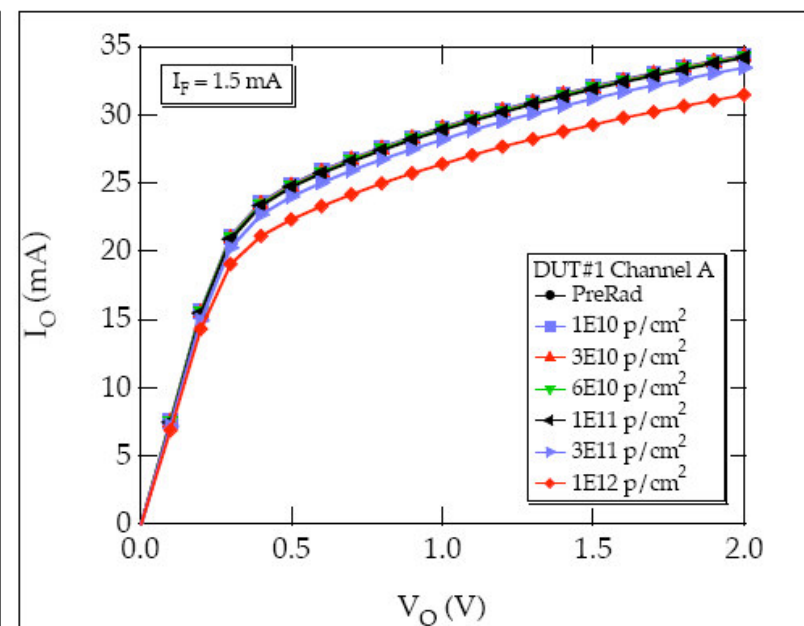
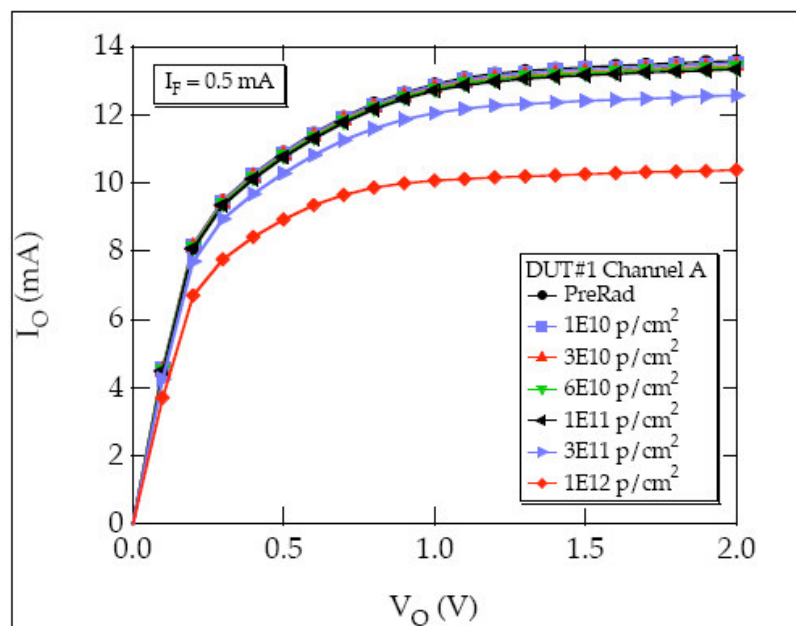
Category 3 – Recommended for usage in some NASA/GSFC spaceflight applications, but requires extensive mitigation techniques or hard failure recovery mode.

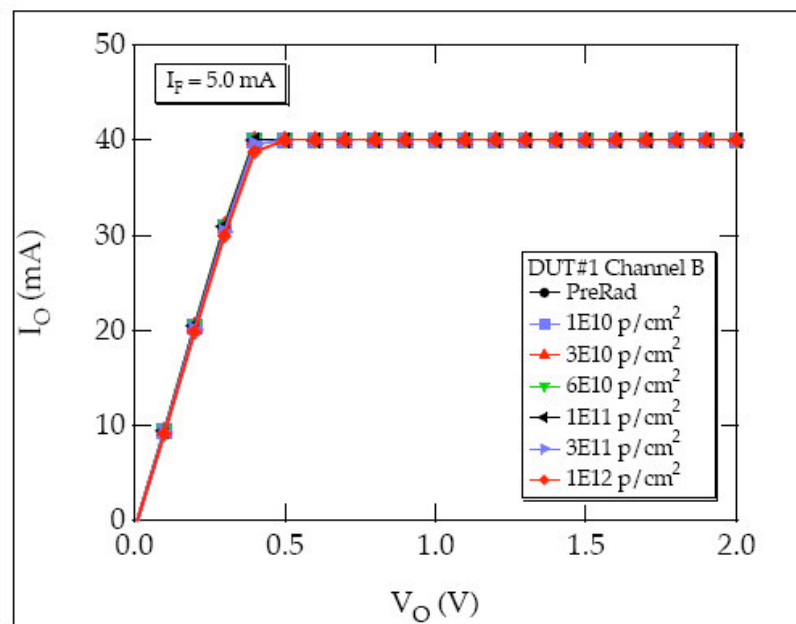
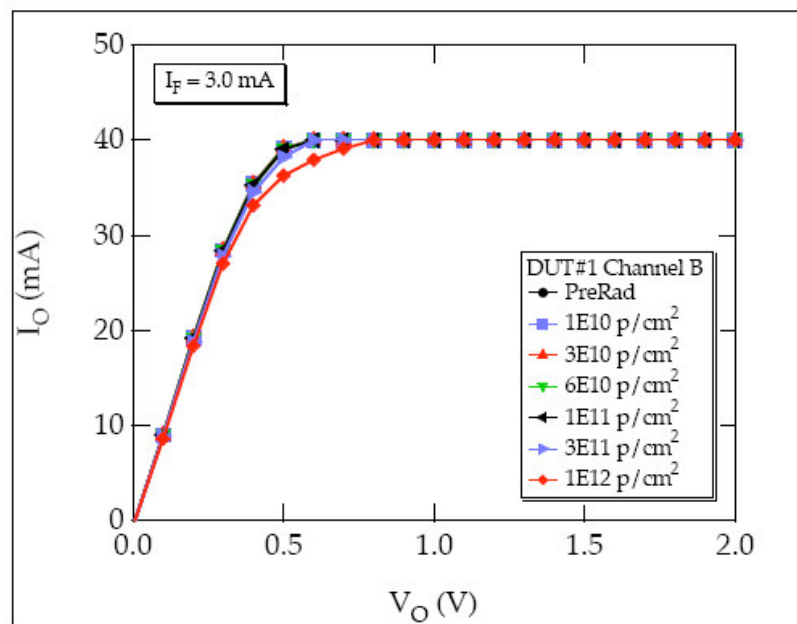
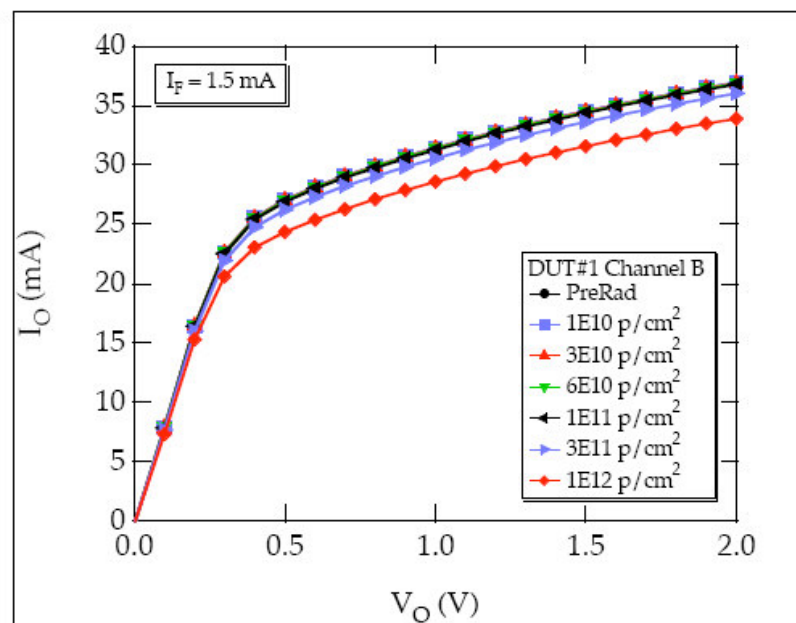
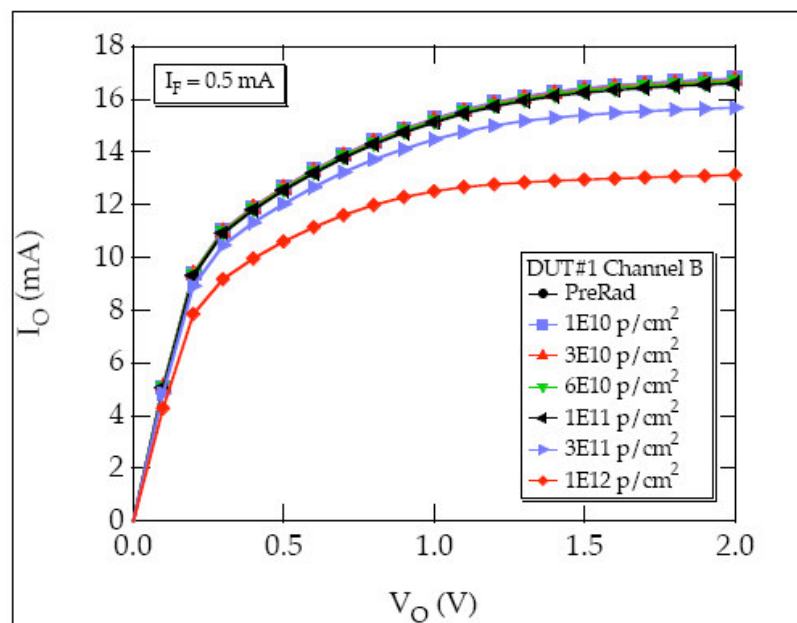
Category 4 – Not recommended for usage in any NASA/GSFC spaceflight applications.

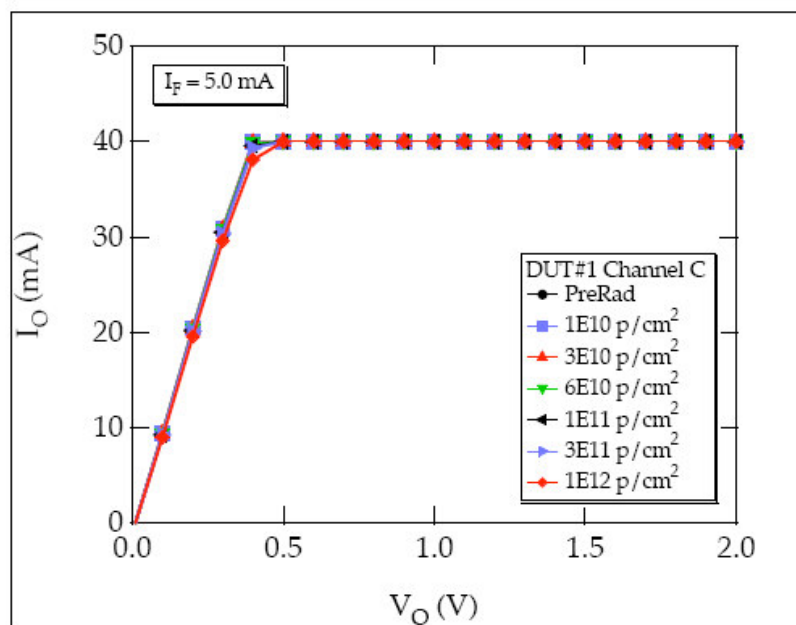
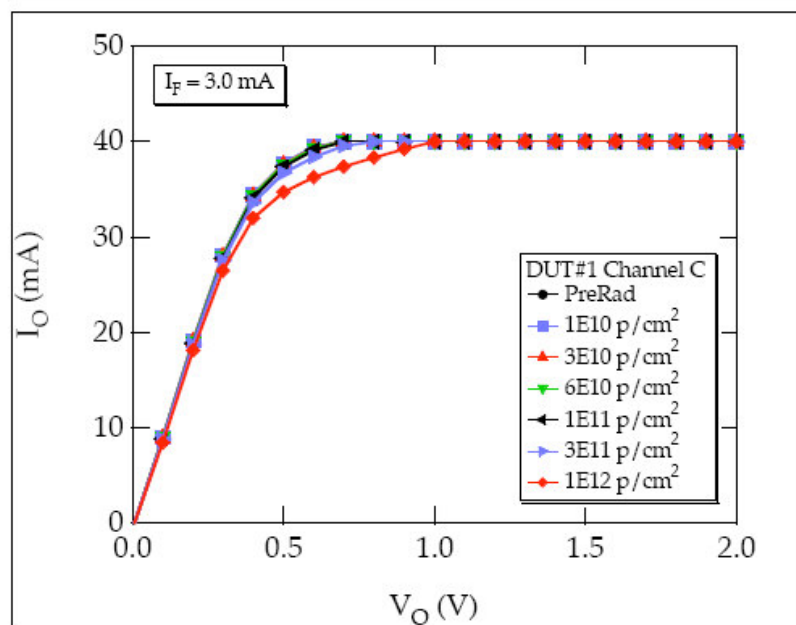
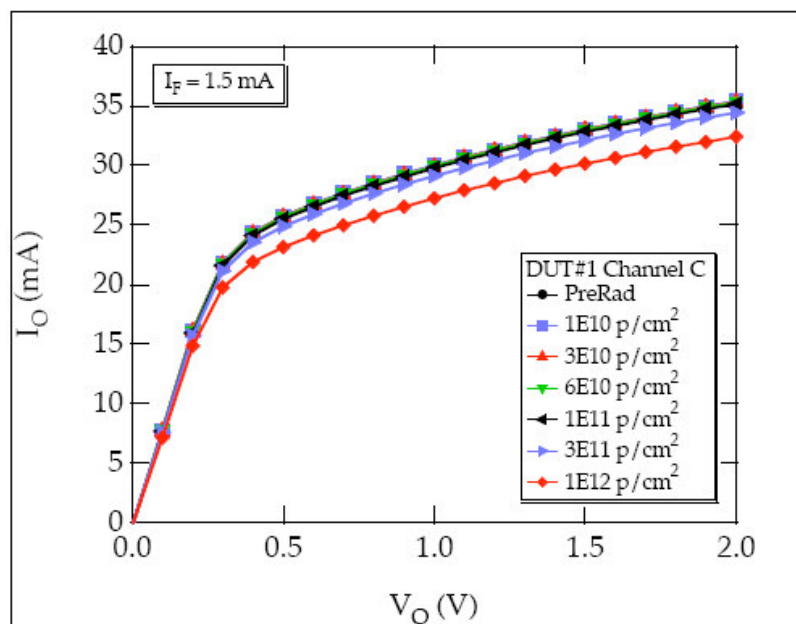
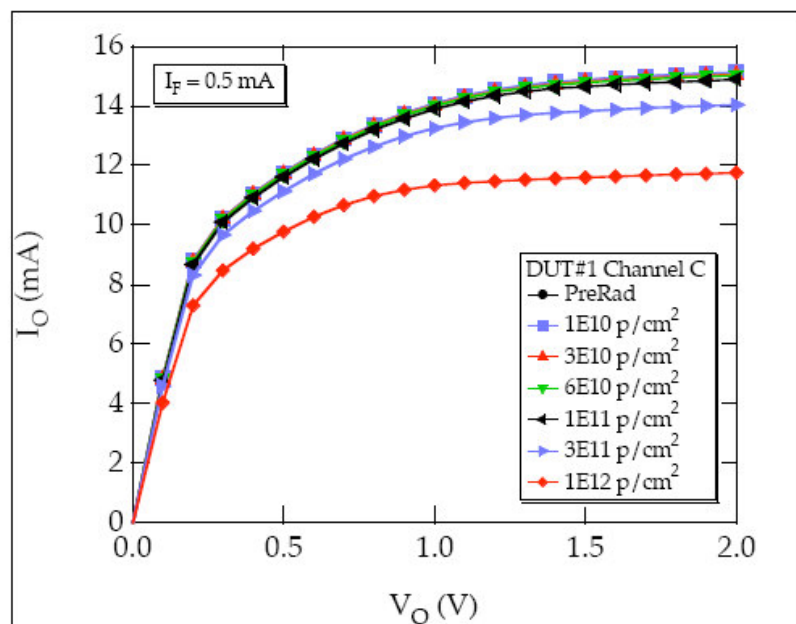
The Agilent HCPL 6751 Optocoupler (8302401FC-X03) are currently considered Category 1 devices with drive currents greater than 1 mA or Category 2 devices with drive currents less than 1 mA.

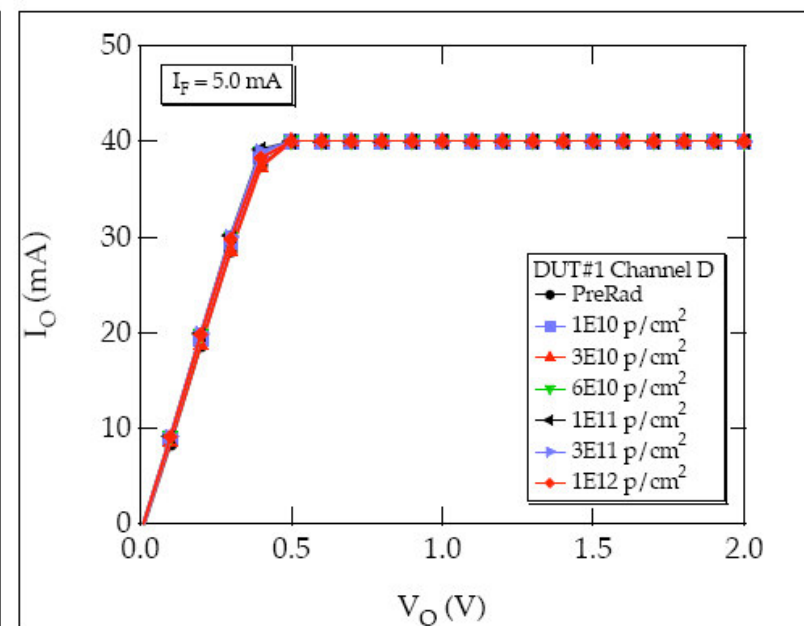
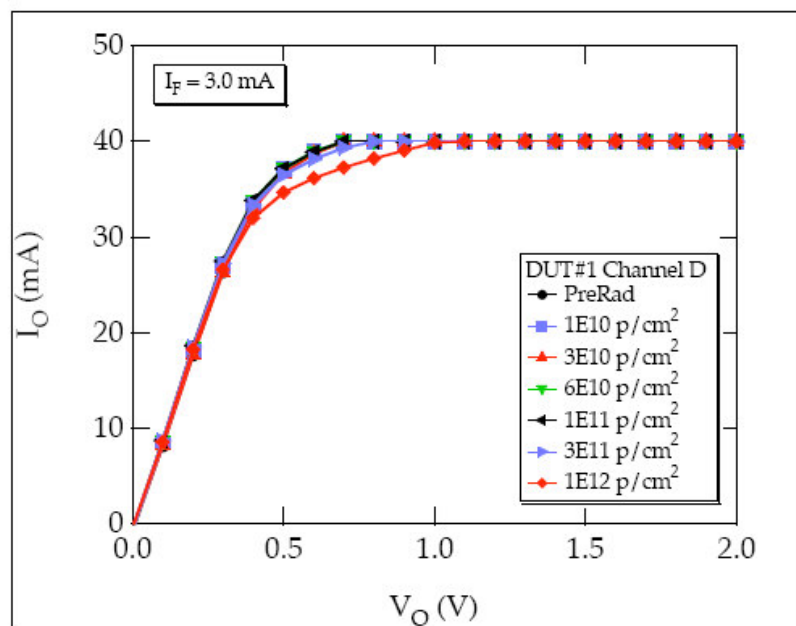
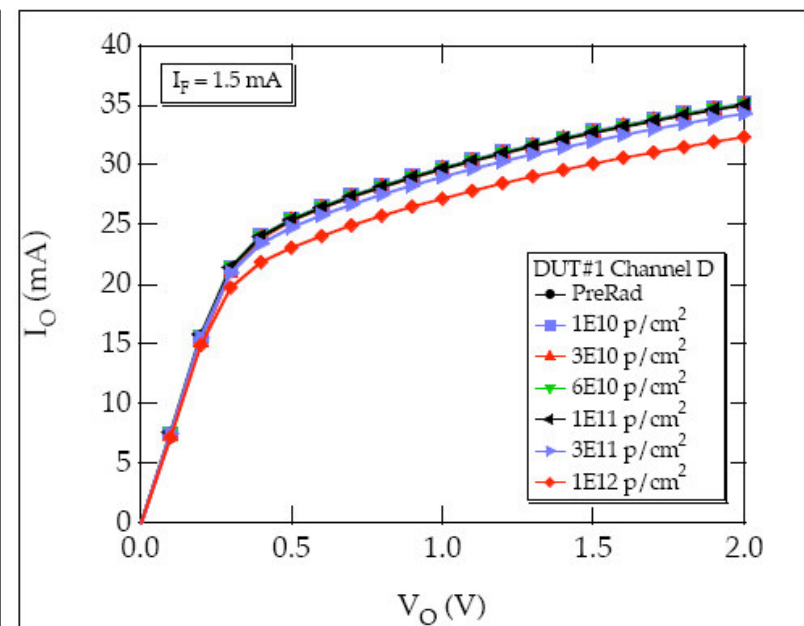
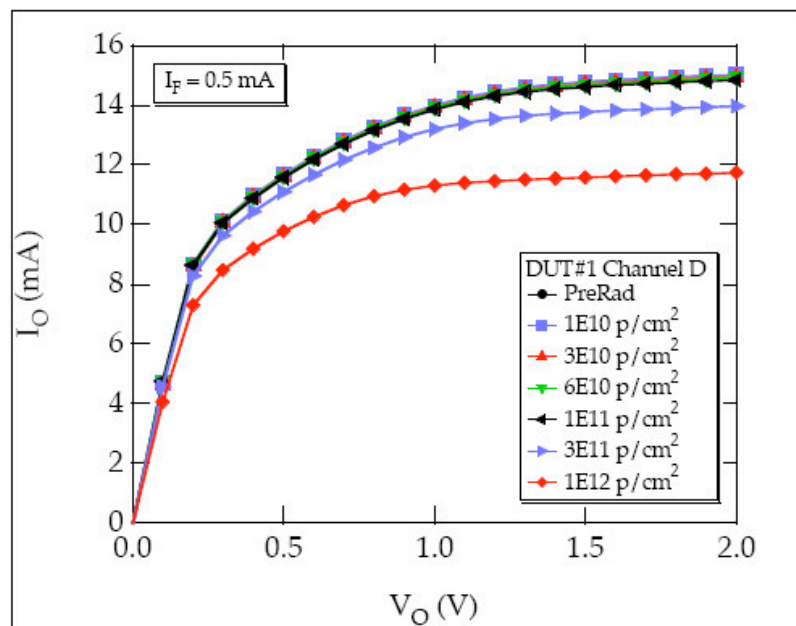
APPENDIX A

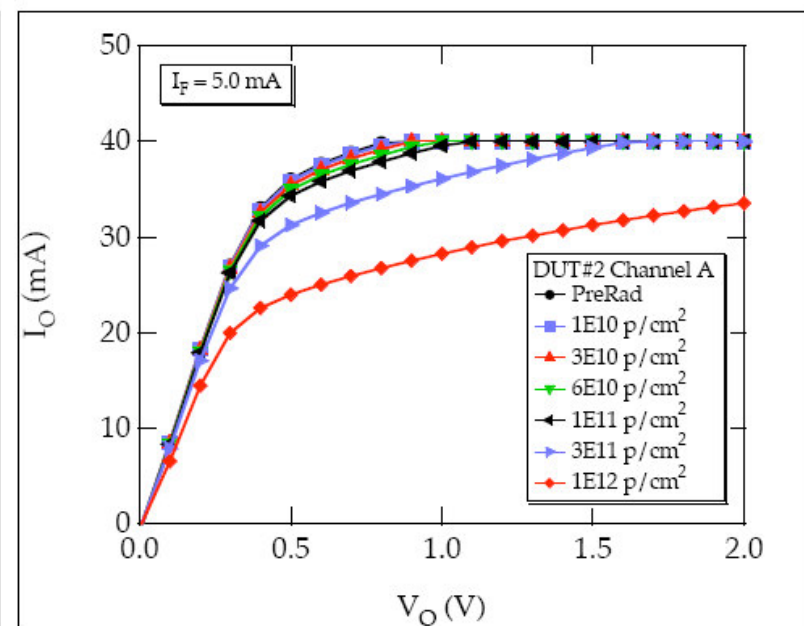
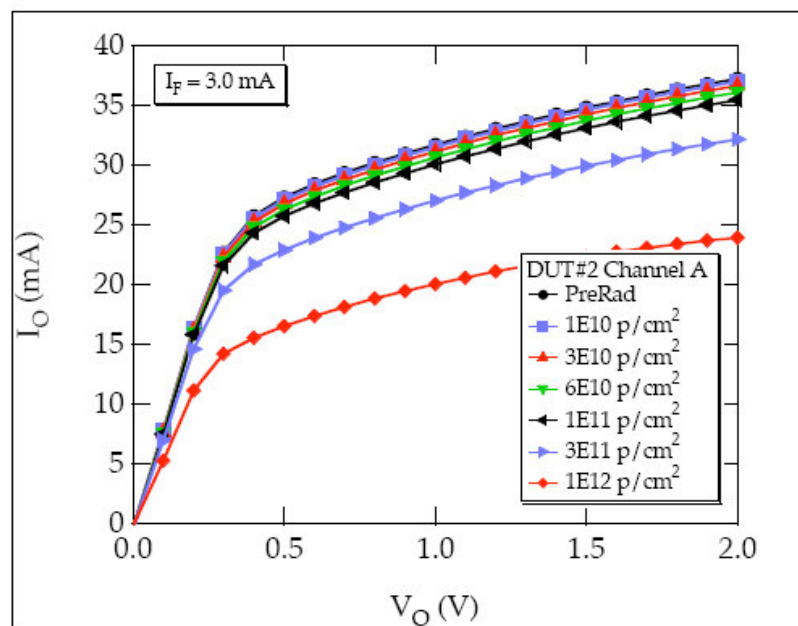
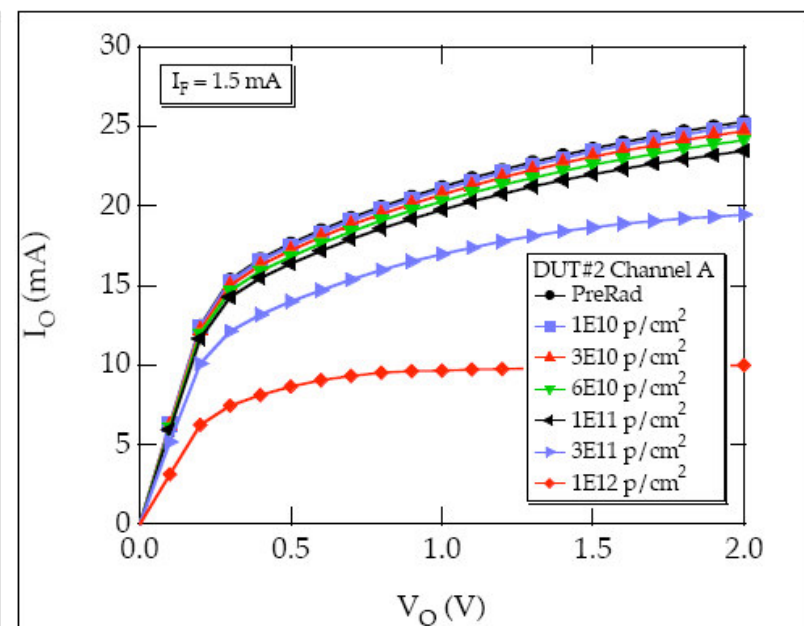
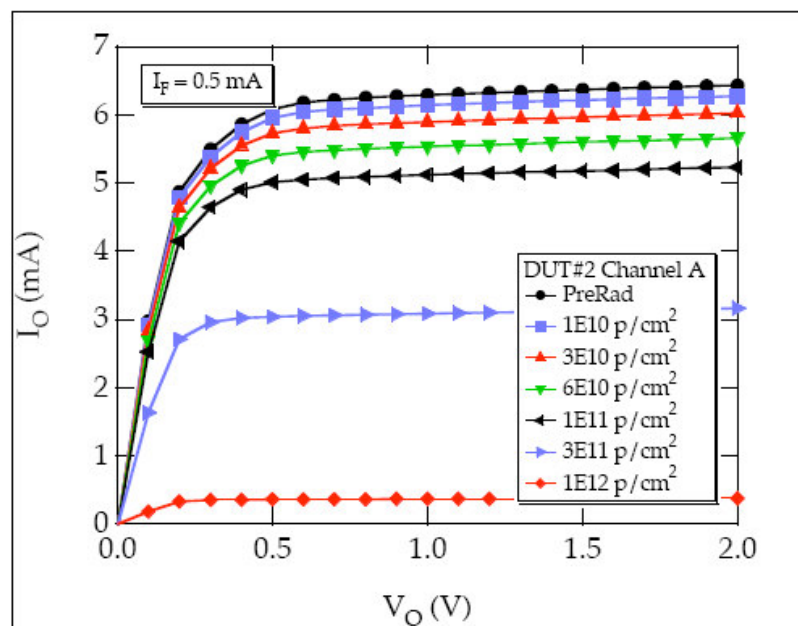
DC Transfer Characteristics

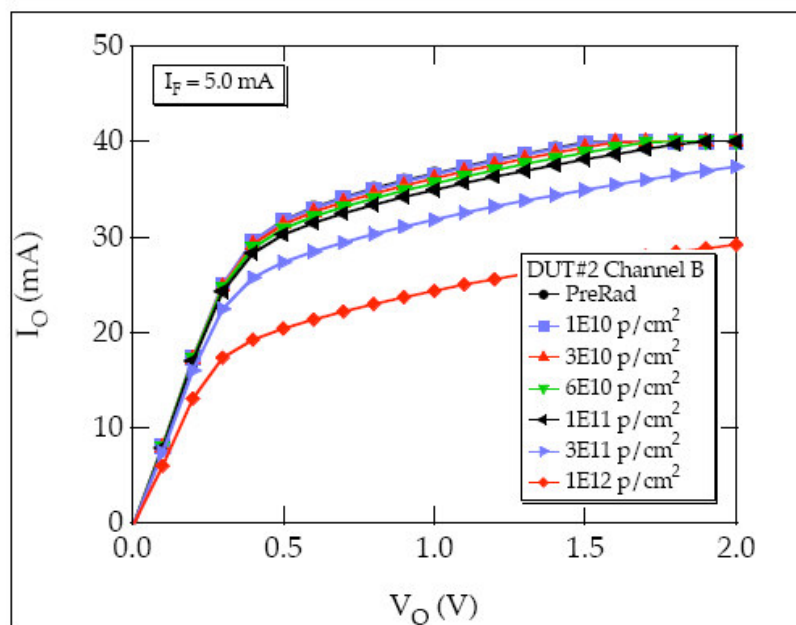
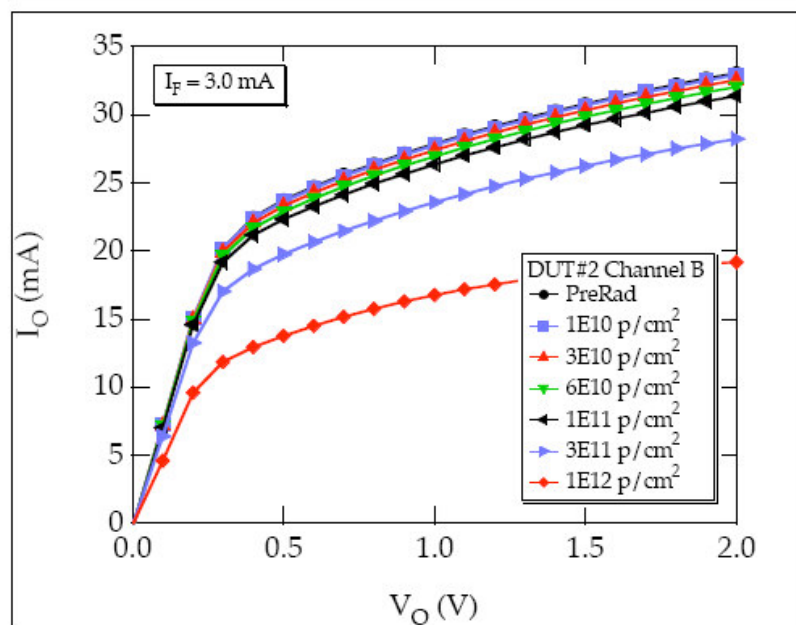
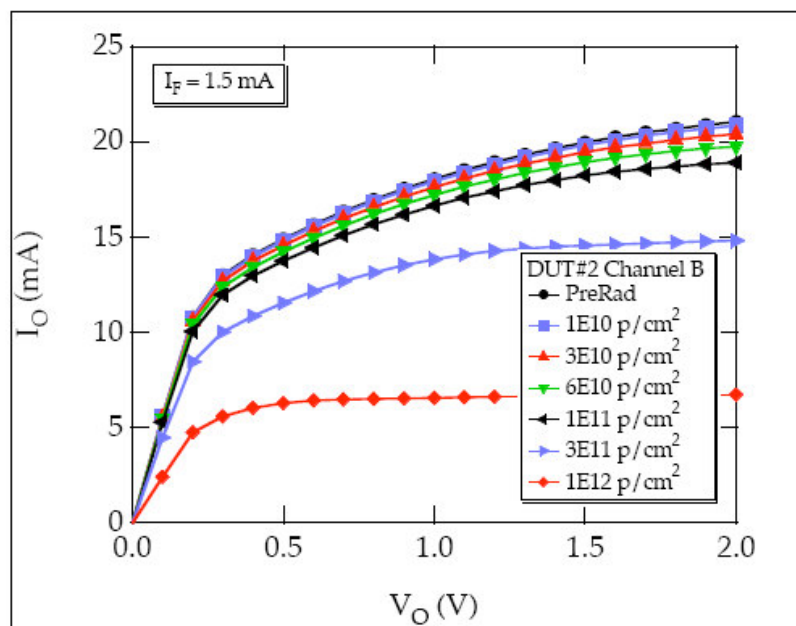
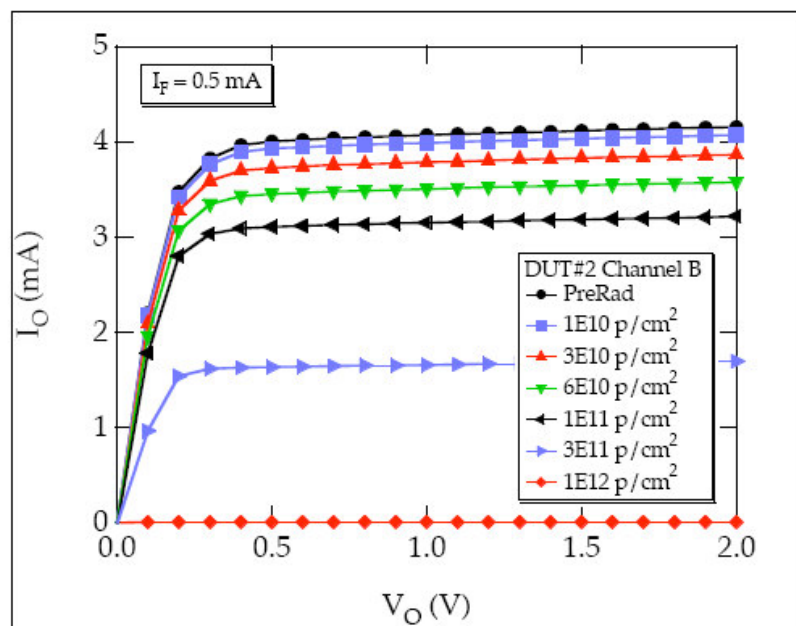


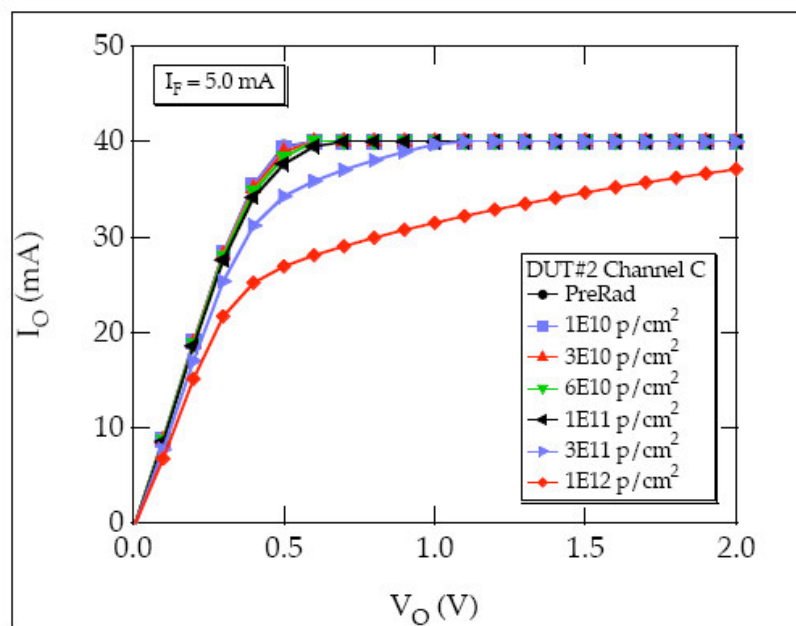
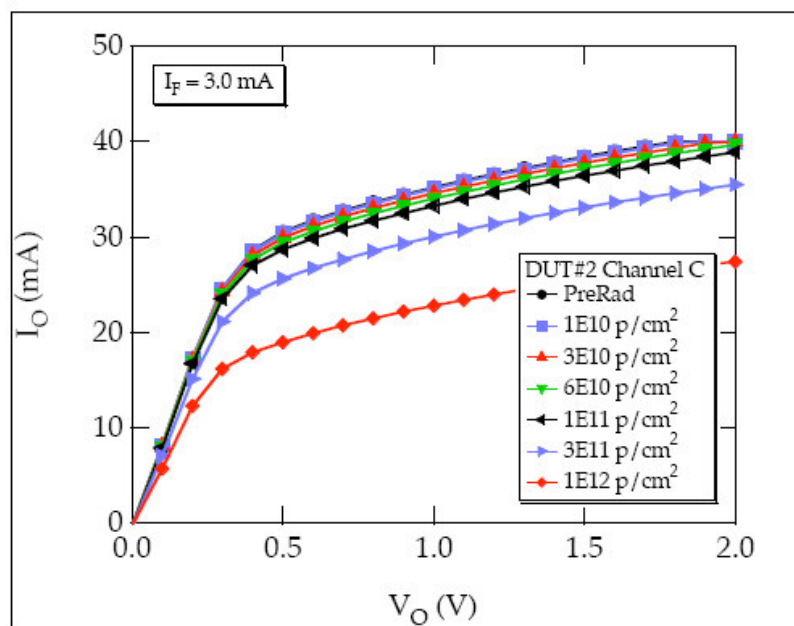
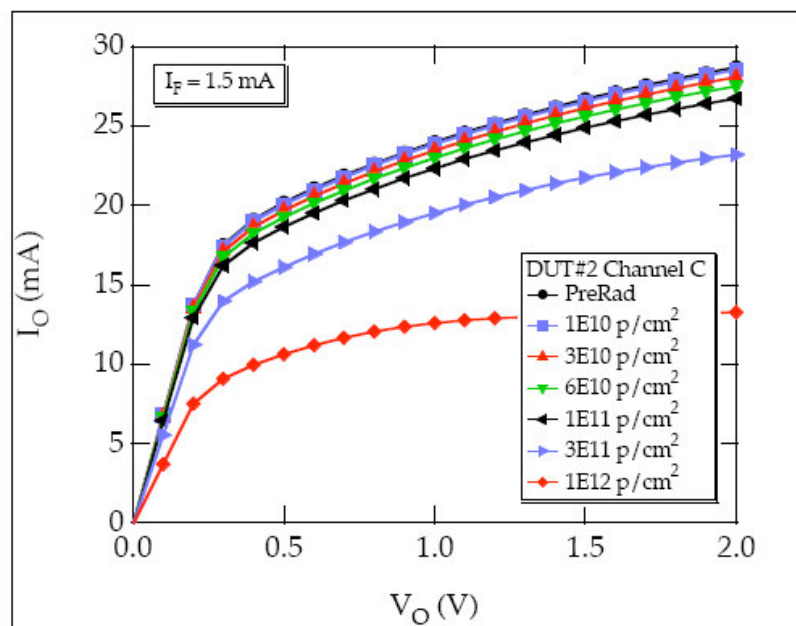
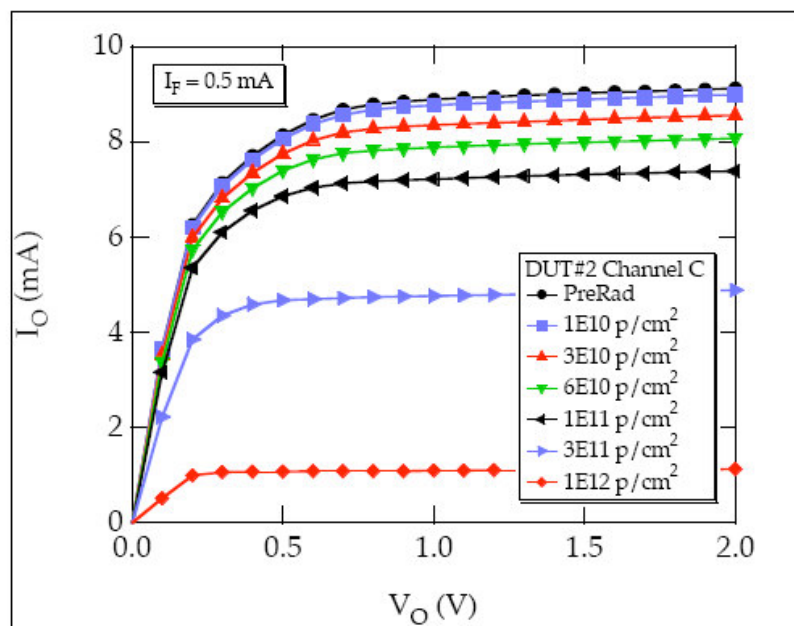


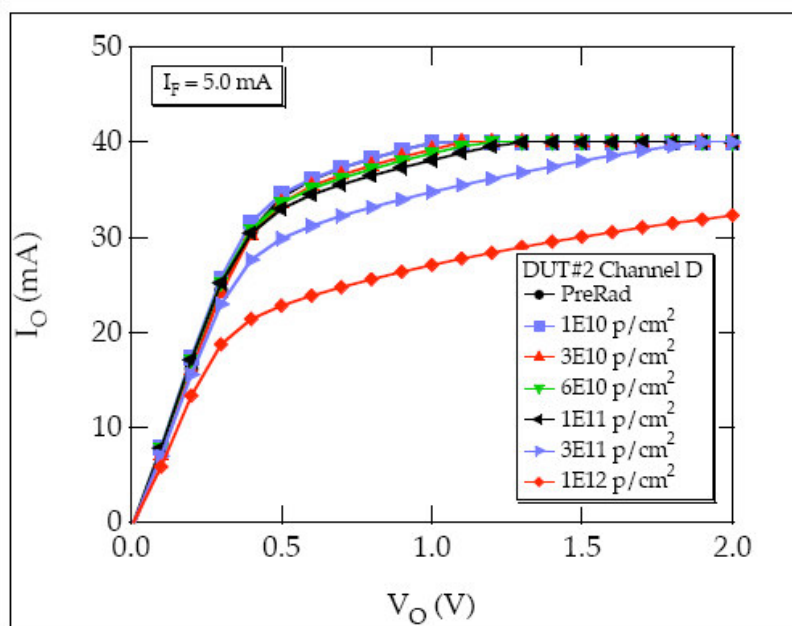
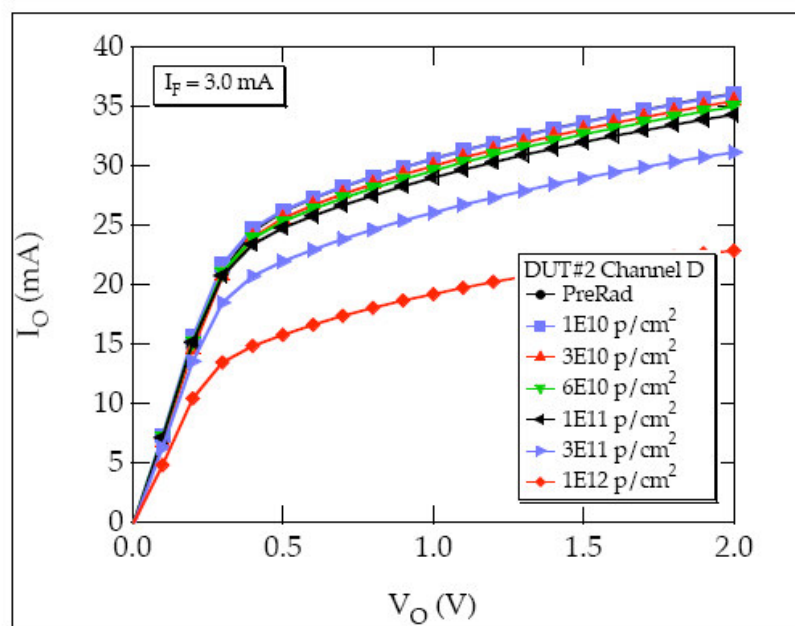
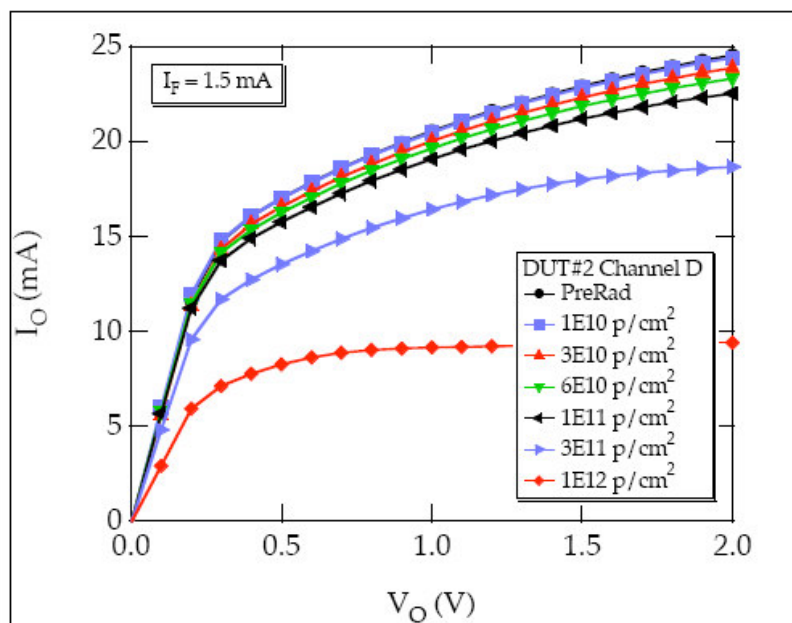
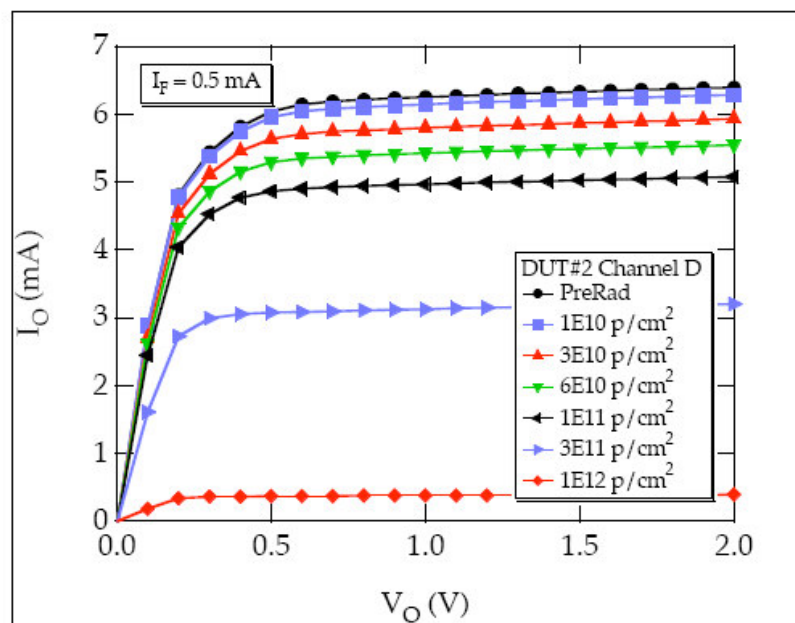


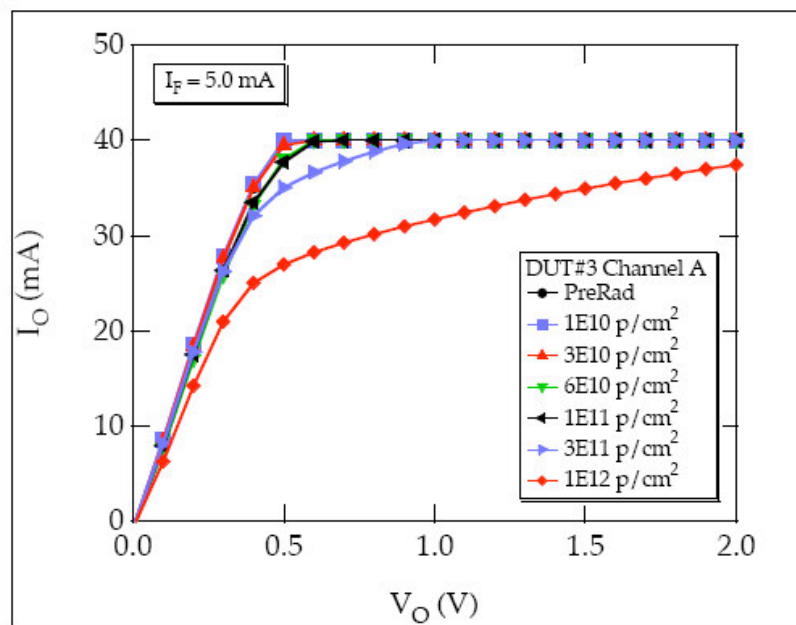
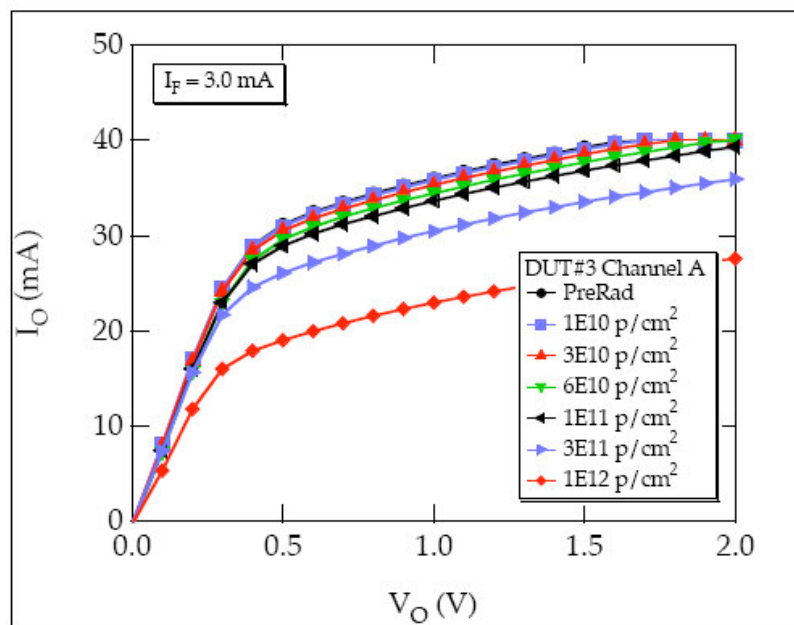
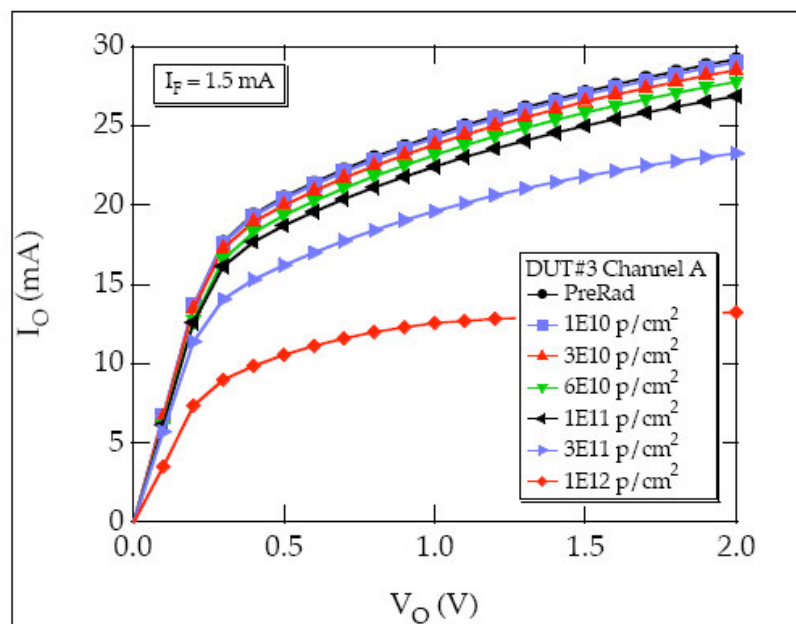
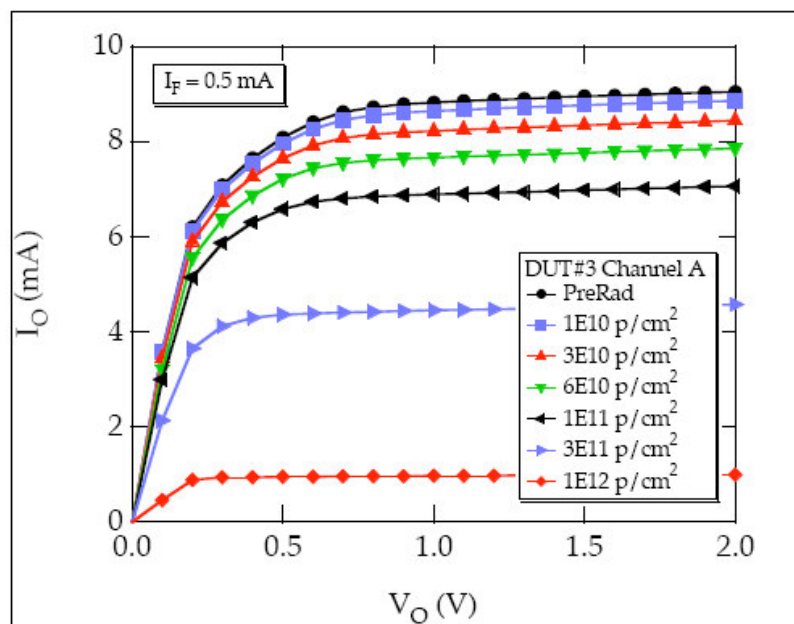


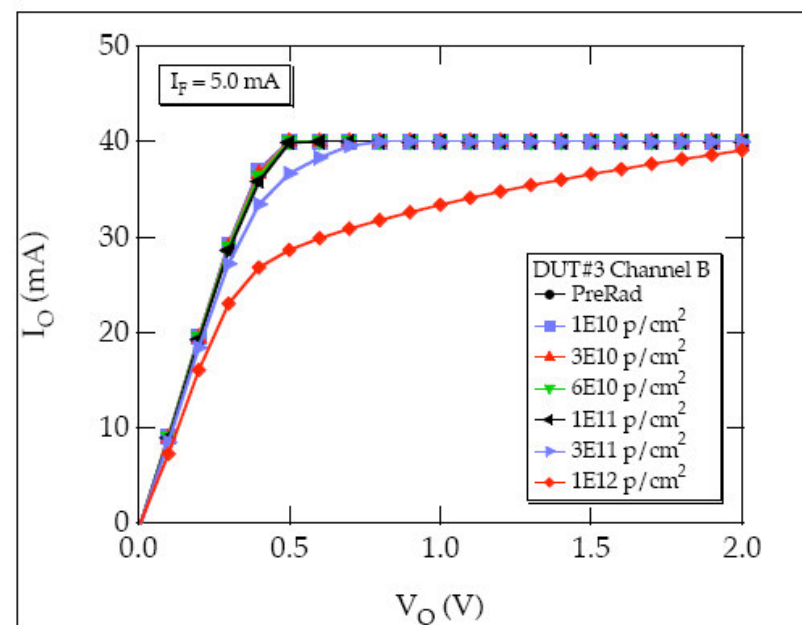
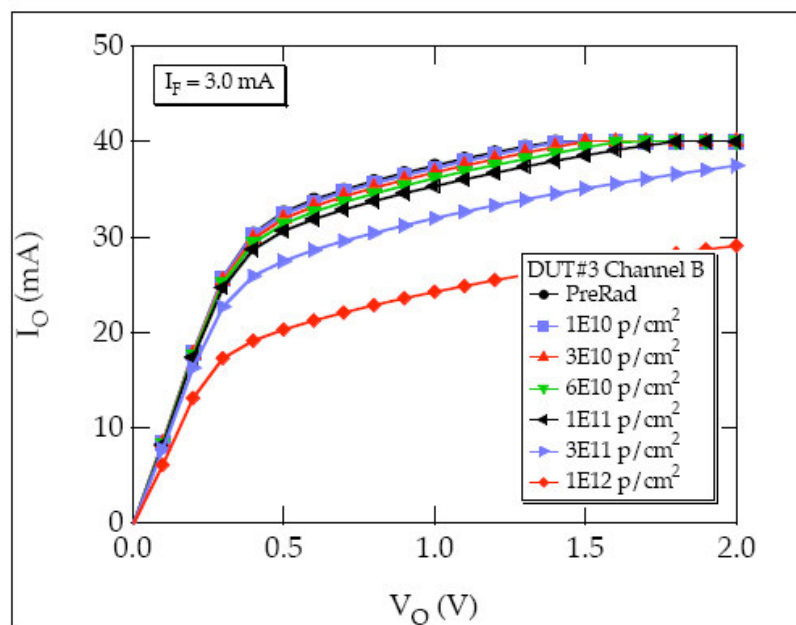
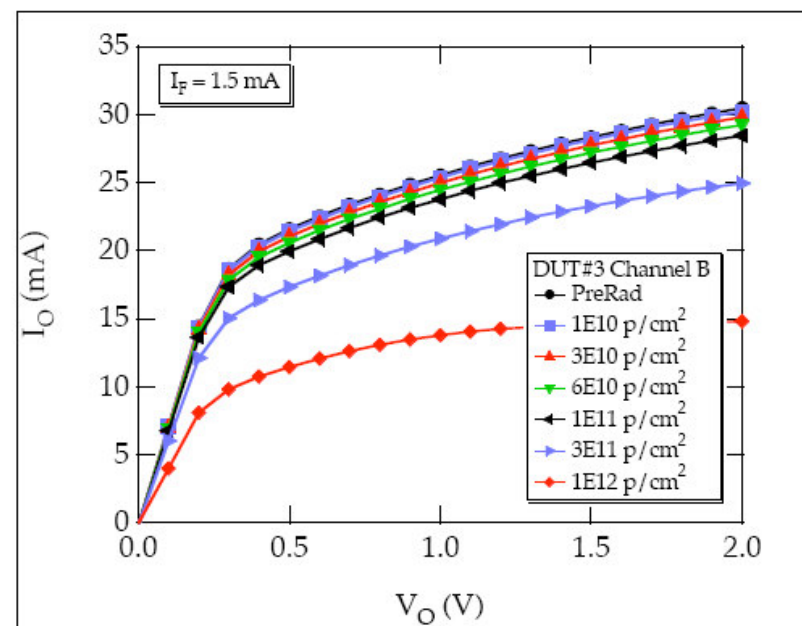
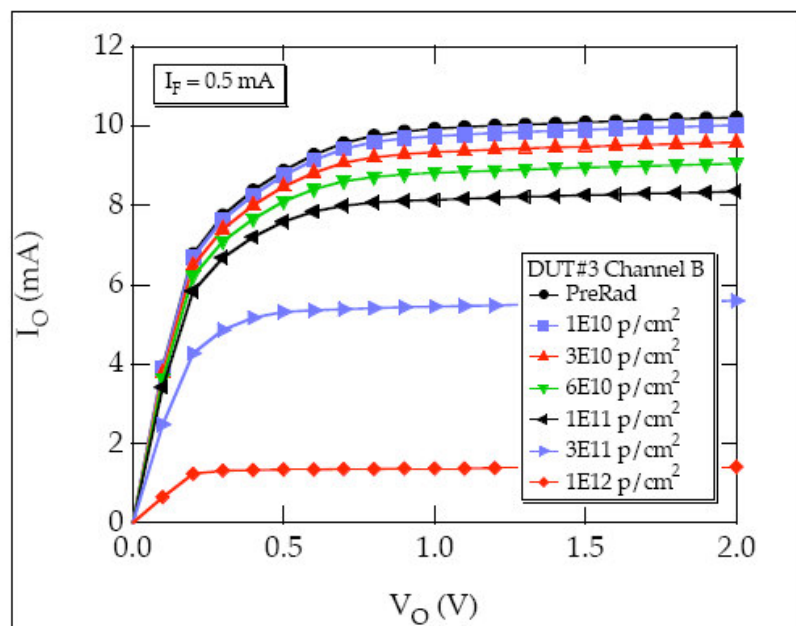


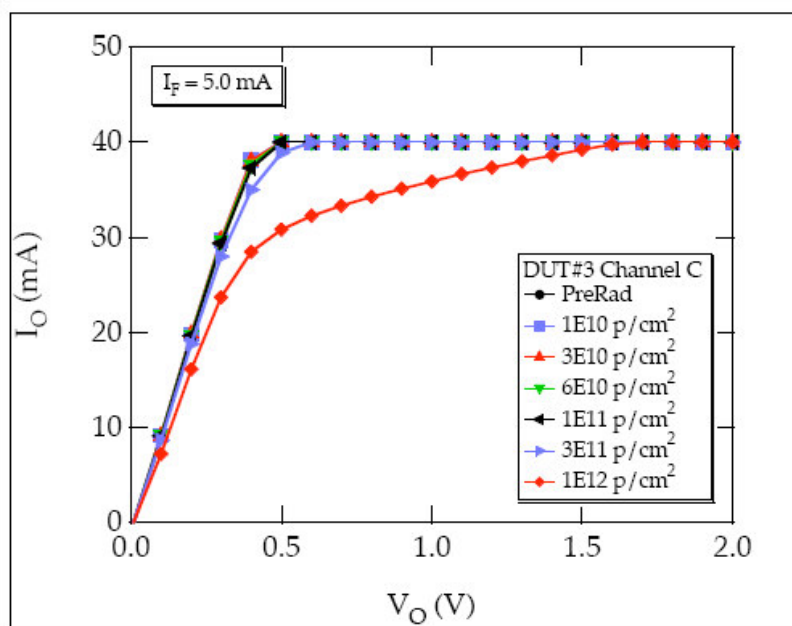
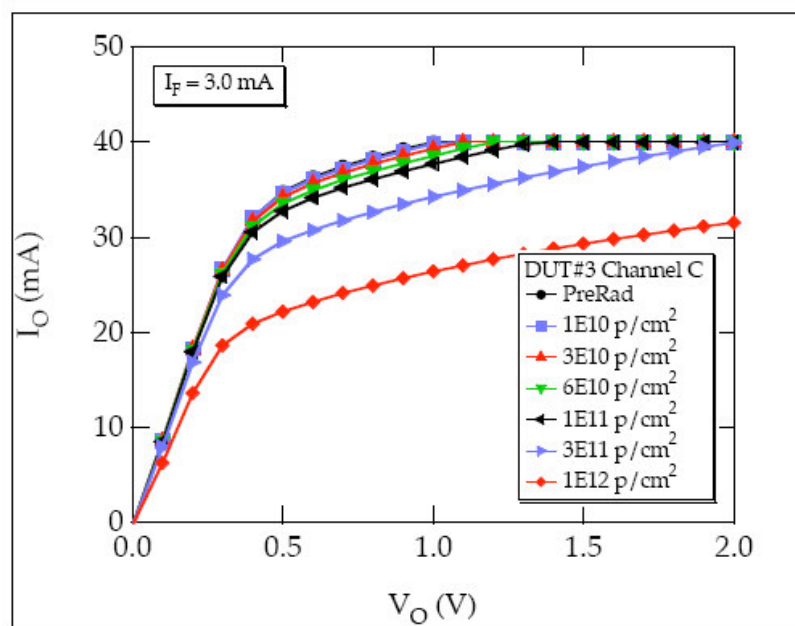
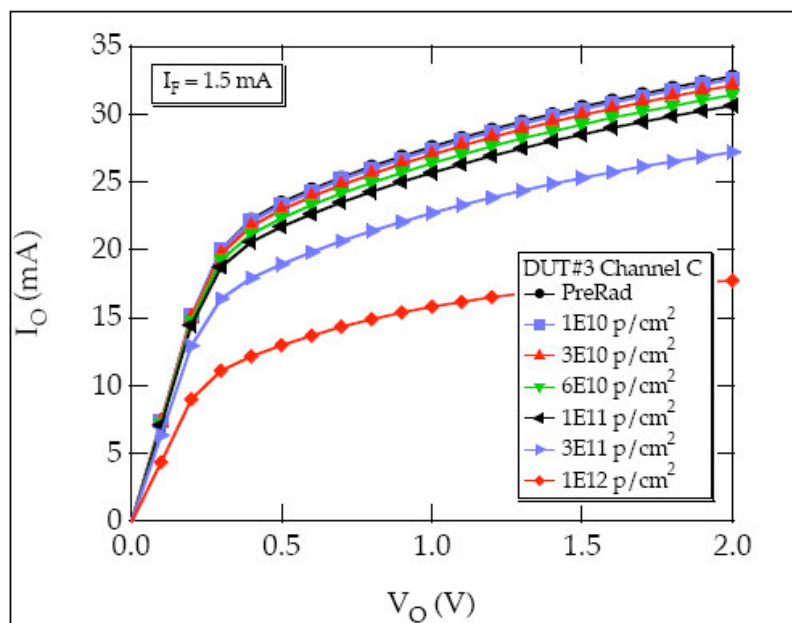
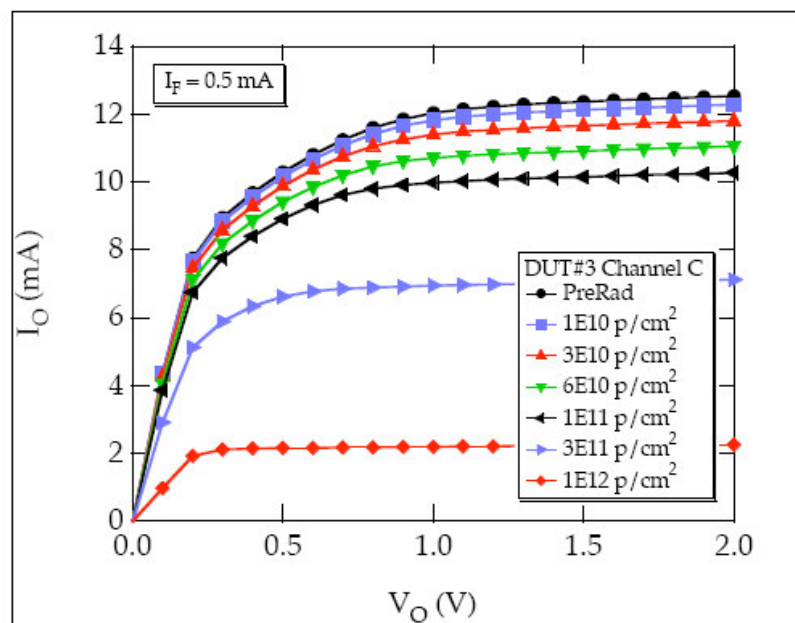


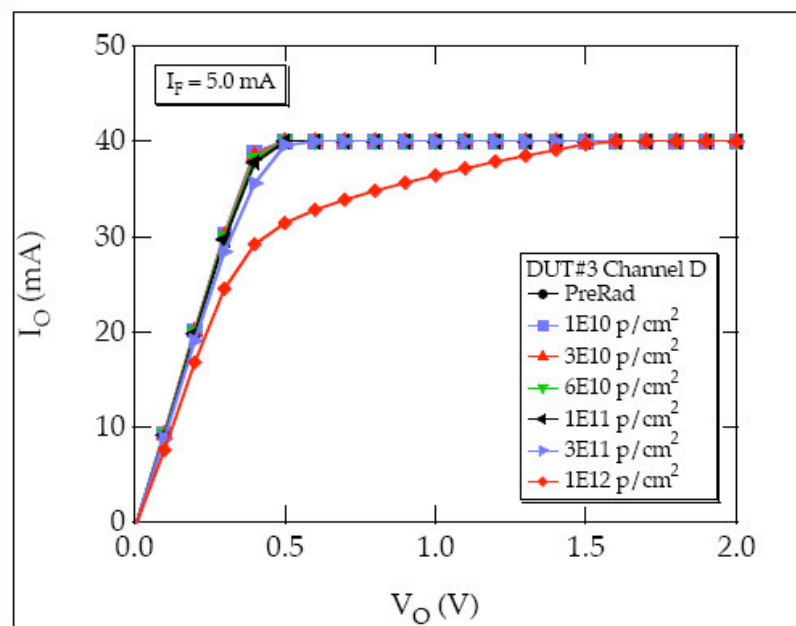
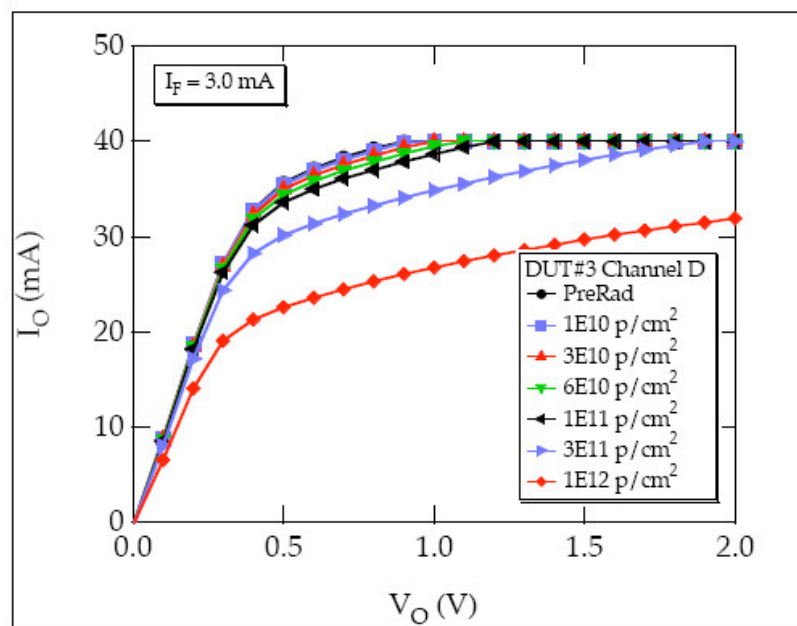
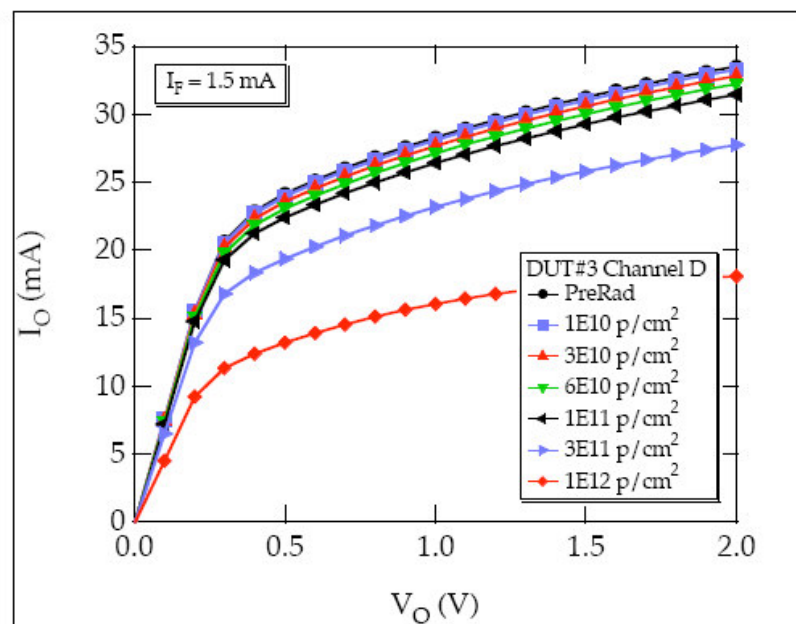
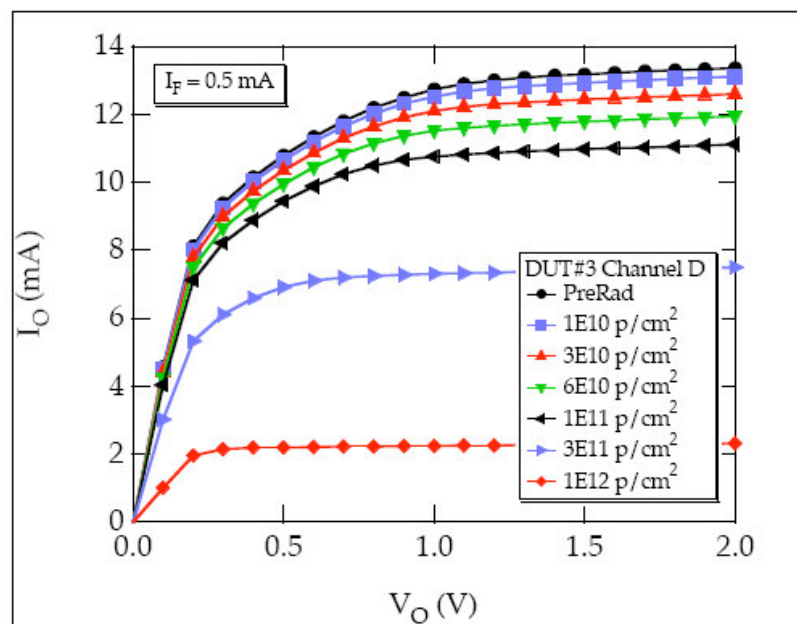












APPENDIX B

Current Transfer Ratio Vs. Input Diode Forward Current

